INFORMATION CIRCULAR 42

Pennsylvania Geological Survey

Fourth Series

GEOLOGIC INTERPRETATION of certain AEROMAGNETIC MAPS of BUCKS, MONTGOMERY, & LEHIGH COUNTIES

by

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FOREWORD

Southeastern Pennsylvania is an area of extremely varied and complex geology with a long history of mineral production. The list of mineral commodities which this area has yielded at various times is considerable, but iron-ore stands out as the most prominent. Scores of iron mines and furnaces have operated in this area in the past 200 years. With a record of production dating back to Pre-Revolutionary War years, the mine at Cornwall is the oldest continuously operating iron mine in the United States. The recent development of the large and magnificent Grace Mine at Morgantown is living testimony to the fact that Pennsylvania's metallic mining record is not simply a story of the past. Through modern methods of exploration and research, new mineral resources remain to be found.

The Bureau of Topographic and Geologic Survey of the Department of Internal Affairs is pleased to have participated and cooperated with the United States Geological Survey in carrying out an aeromagnetic survey of Southeastern Pennsylvania. This modern exploration technique is particularly well suited to the geologic conditions and to the potential mineral resources of the area; it is an extremely efficient method of acquiring geologic data for a large region. The results of the aeromagnetic survey are being published by the United States Geological Survey as a series of aeromagnetic contour maps.

We are pleased to present this publication as a service to the Commonwealth of Pennsylvania. It is hoped that this interpretation and discussion of the aeromagnetic maps will serve as a stimulus for further research and development.

Genevieve Blatt

Genevieve Blatt, Secretary
Department of Internal Affairs

GEOLOGIC INTERPRETATION OF CERTAIN AEROMAGNETIC MAPS OF BUCKS, MONTGOMERY, AND LEHIGH COUNTIES

General Statement

The magnetic contour maps being discussed in this series of publications are the result of a cooperative project of the United States Geological Survey and the Pennsylvania Geological Survey, Department of Internal Affairs. About 5,000 square miles of southeastern Pennsylvania have been covered in this survey, the results of which are being published as individual 7 1/2-minute quadrangle maps.

This information circular is one of a series intended as a preliminary explanation of the interrelation of distinctive magnetic features with geological conditions in each quadrangle. In many instances unusual magnetic patterns can be explained by geological features which have been mapped and studied in the past. It is hoped that the map viewer will not only be aided by such correlation of data, but that this publication may stimulate exploration and research in those areas where there is at present no known or satisfactory geological explanation for some of the magnetic features which appear on the magnetic contour map. Such exploration and research could directly or indirectly lead to discovery and development of new mineral deposits and would greatly further the basic knowledge of the geology of Pennsylvania.

The magnetic contour lines on the map are lines connecting points of equal magnetic intensity. The shape, position, and spacing of the magnetic lines are due to the combined effects of the earth itself, which is a huge magnet, and to the local variations in the magnetism of the rocks underlying any given area. If only the earth as a large, uniform body were responsible for the magnetic lines, they would be essentially straight and simple. It is the local geology, however, which imparts complexities to the patterns of the magnetic lines. Such complexities or variations from a simple pattern are called anomalies.

Local magnetic effects vary from place to place because the magnetic properties of the respective rocks are not alike or because differences in rock structure from place to place change the magnetism measured at the surface. Rocks which have different kinds or different relative amounts of minerals, particularly iron-bearing minerals, have unlike magnetic properties. In general, the more iron minerals present, the stronger the magnetic effect. The iron oxide mineral, magnetite, has a strong magnetic effect even when present in small quantities; when present in large amounts, magnetite is of economic interest as a possible iron ore.

If in a given area the rocks have been folded or faulted by internal earth forces, the resulting variation in position of the different rocks will be indicated by variation in magnetic readings from place to place. Thus, structural complexities as well as mineral variations may be revealed by the magnetic data. Of particular interest are those magnetic variations or anomalies which are circular or tend to enclose a given area; the implication in such cases is that there is a specific, localized causative factor more or less pin-pointed by such a pattern.

The aeromagnetic survey of southeastern Pennsylvania was carried out with the use of an airborne magnetometer, an instrument towed by a plane. The plane covered the area by flying back and forth along straight, parallel flight lines spaced a quarter mile apart. An attempt was made to maintain an elevation of 500 feet, above the ground so as to eliminate magnetic changes due solely to terrain changes. An airborne magnetic survey has the advantage of eliminating very minor magnetic features on the ground, thus permitting a better evaluation of larger and deeper magnetic phenomena. It should be borne in mind that the instruments which have measured the magnetic effects in these studies are very sensitive and capable of detecting small changes. Proper evaluation of these changes is necessary to distinguish those situations which offer possibilities for economic mineral development from those cases where the information yielded is of more academic interest.

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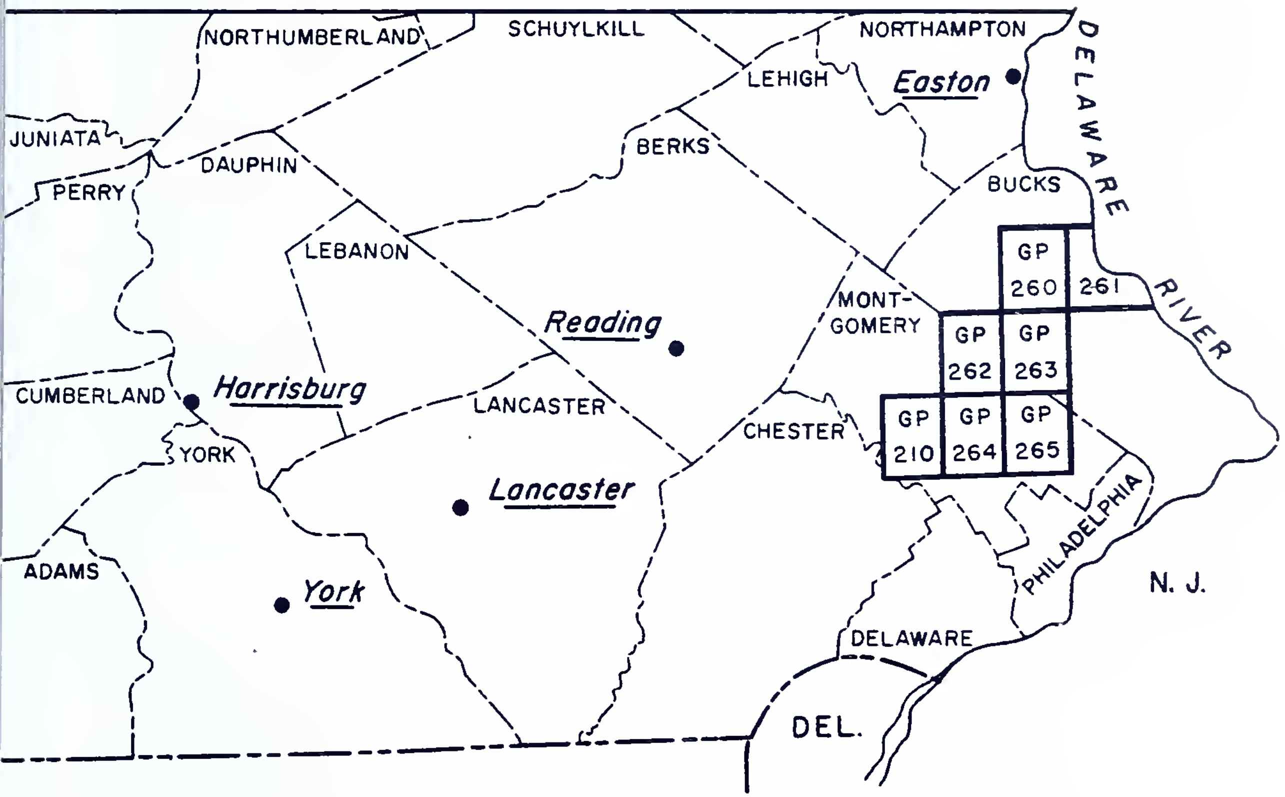
COVERED IN THIS PUBLICATION



GP 210 Collegeville quad.
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Collegeville Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 210

The Collegeville aeromagnetic map exhibits a simple contour pattern with a range of no more than 150 gammas throughout the quadrangle. This is an area underlain by Triassic shales and sandstones of the Brunswick, Lockatong, and Stockton Formations; these sediments dip uniformly north-northwest and apparently have uniform magnetic intensities. No significant mineralization or variation in structure is indicated.

Bedminster Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 260

The Bedminster aeromagnetic map exhibits a simple magnetic contour pattern with a total relief of only 250 gammas in the entire quadrangle. This is an area almost entirely underlain by Triassic Brunswick and Lockatong sandstones and shales of essentially uniform magnetic intensity; the edges of gentle dipping intrusive diabase sheets in the northeast and northwest corners of the quadrangle contribute 150 gammas to the very moderate magnetic relief of the quadrangle. No significant mineral or structural variation is indicated.

Lumberville Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 261

The Lumberville aeromagnetic map has only a few, widely spaced contour lines; the total magnetic relief in the quadrangle is 250 gammas. Were it not for a small area of intrusive Triassic diabase in the very northwest corner of the quadrangle, the magnetic relief would only be about 100 gammas. This area has a thick sequence of Lockatong, Brunswick, and Stockton sandstones and shales which dip uniformly to the northwest. No mineralization or significant structural features are indicated by the magnetic data.

Telford Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 262

The Telford aeromagnetic map has an extremely simple magnetic contour pattern with only 200 gammas range in the quadrangle. The area consists primarily of interbedded Lockatong and Brunswick shales and sandstones of Triassic age and exhibits uniform magnetic intensity; in the northwest corner of the quadrangle the edge of a gently dipping. intrusive Triassic diabase mass accounts for most of the existing magnetic relief of the quadrangle. The east-west trending Chalfont Fault cuts through the center of the quadrangle but there is no manifestation of it on the aeromagnetic pattern, nor is there any indication of any other structural variations or mineralization.

Doylestown Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 263

The Doylestown aeromagnetic map shows a simple magnetic contour pattern with only 140 gammas relief in the entire quadrangle. The area consists of Triassic Brunswick, Lockatong, and Stockton shales and sandstones of essentially uniform magnetic intensity. The swing in the trend of the magnetic contours to an east-west trend in the southern half of the quadrangle tends to reflect variations along an east-west fault which has been mapped in the area. No mineralization is indicated by the magnetic pattern.

Lansdale Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 264

The Lansdale aeromagnetic map exhibits a magnetic relief of 200 gammas, most of which is due to a minor anomaly in the southeast corner of the quadrangle. The map covers an area underlain by Triassic sandstones and shales of the Brunswick, Lockatong, and Stockton Formations which dip uniformly to the northwest. The southern part of the quadrangle is near the thin, southern edge of the Triassic wedge of sediments and the magnetic anomaly in the southeast corner probably is due to a minor variation in the mineralogy of the Lower Paleozoic or Precambrian rocks under the Triassic sediments. No significant mineralization or structural variation is indicated in this quadrangle.

Ambler Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 265

The Ambler aeromagnetic map shows a northeast-trending magnetic low over the town of Spring House and a northeast-trending magnetic high over Fort Washington. Neither of these anomalies is an intense feature, each varying about 250 gammas from the regional norm. While both of these anomalies occur over northwest-dipping, Triassic Lockatong and Stockton sediments, these areas are near the southern, thin edge of the Triassic wedge of sediments. Thus, the anomaly sources are undoubtedly in the underlying Precambrian and Lower Paleozoic rocks. This conforms with the situation which was found in the Hatboro and Langhorne quadrangles where anomalies in the older rocks can be observed to continue across the Triassic contact and under the Triassic sediments. Consideration of the small magnetic amplitude and the depth of burial of the pre-Triassic rocks suggests the anomaly is the result of minor variations in mineral composition. No significant mineralization or structural variation is indicated.

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